# **Technical specifications for K. Kandu Oiy Giri cold storage and quick freezer**

REFRIGERATION SYSTEM DESIGN SOLUTION DESCRIPTION

## Outdoor Design Parameters

1. Project Location: Maldives
2. Outdoor design parameters
   1. Calculated temperature outside the ventilation: +32.2 °C;
   2. Calculated daily average temperature outside the air conditioning room: +30.5 °C;
   3. The average 50-hour wet bulb temperature per year outdoors is not guaranteed: +28.1°C;
   4. Calculated relative humidity outdoors: 80%;

(5) Condensation temperature: 35 °C;

## Construction Scale

The project site is in the Maldives and requires the construction of a new 200-tonne cold storage and a 10-tonne/8 h quick-frozen vault. The quick-frozen and 200-ton reefers use a refrigeration system that requires a screw compressor for ammonia and an ammonia pump for liquid supply. The freezer is equipped with a stainless-steel tube aluminum sheet air cooler, and the freezing room requires a total of 10 tons per purchase and freezes to the core temperature within 8 hours- 18 degrees. The temperature requirement of the cold storage is -30 degrees, the stainless steel 304 tube aluminum sheet air cooler is adopted, and the cold air cooler adopts the form of water frost.

## The construction scale of this project is as follows:

**Cold room technical requirements and parameter table**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| serial number | Cold room name | Floor area m2 | Net height  （m） | Theoretical calculation of nominal tonnage (T). | quantity | Inbound volume | Storage temperature (°C). | Outbound temperature  （℃） | Cooldown time  （h） | room temperature  （℃） |
| 1 | Quick freezing room | 50m2 | 5 | 10T | 1 | 10T | +25 | -20 | 10 | -30 |
| 2 | refrigerator | 218 | 6 | 200T | 1 | 10% | -15 | -24 | 12 | -30 |

**\*20 tons of Tuna from -15oto -22 oC within 12 hours and maintain 200 tons of frozen Tuna withing -22oC-24oC.**

Note (1): The above table is a drawing parameter, as the basis for the calculation of the refrigeration scheme, if the parameters change, the scheme needs to be changed accordingly.

(2) The value of the heat flow per unit of the enclosure structure: 10W/m2, which is required to meet this value for the owner building and the insulation structure.

## Design basis

* 1. "Cold Storage Design Code" GB50072-2021
  2. "HVAC Design Code" GB50019-2012

(3) Industrial Metal Pipe Design Code GB50316-2000 (2008 Edition).

1. "General Principles of Insulation Technology for Equipment and Pipes" GB/T4272-2008
2. "Equipment and Pipe Insulation Design Guidelines" GB/T8175-2008
3. "Pressure Pipeline Safety Technical Supervision Regulation Industrial Pipelines" TSG D0001-2009
4. "Pressure Pipeline Specification Industrial Pipeline" GB/T 20801-2006
5. "Specification for the Construction and Acceptance of Installation works of ammonia refrigeration systems" SBJ 12-2011
6. "Specification for the Construction and Acceptance of Installation Projects of Refrigeration Equipment and Air Separation Equipment" GB 50274-2010
7. "Industrial Equipment and Pipeline Thermal Insulation Engineering Construction Quality Acceptance Specification" GB50185-2010
8. Field Devices Industrial pipe welding engineering construction code GB 50236-2011
9. "General Specification for Construction and Acceptance of Mechanical Equipment Installation Project" GB 50231-2009
10. Other applicable national and local norms, regulations and standards
11. Technical parameters, building plans and related information provided by the owner

In line with the technical level of advanced, mature, economical, and practical, simple operation, reliable operation, energy saving principles, the formulation of this program. This solution includes refrigeration systems.

## The Refrigeration System Design Scheme

**1. the division of the cold system:** abide by the safety, energy saving, economy, simple operation of the principle of division system.

**2. Refrigeration working fluid:** ammonia (R717); **refrigeration oil:** special oil for **ammonia making agent**.

**3. Liquid supply mode:** pump liquid supply.

**4. Control mode:** automatic/manual liquid supply.

**5, melting method:** hand command automatic water flushing

## System Division:

**(1)** **, quick freezing room** **+** **refrigeration room system:** refrigerant: NH3

Evaporation/condensation temperature: -40°C/+35°C Liquid supply type: pump liquid

## Cold Room Design Load

**According to the owner's requirements, determine the system design load**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| serial number | Room name | Room temperature °C | Number of rooms | Single room device negative  Lotus (kw). | Total mechanical load  （KW） | Evaporation temperature °C |
| 1 | Quick freezing room | -30 | 1 | 280 | 250 | R717/-40 |
| 5 | refrigerator | -30 | 1 | 31.6 |

## Selection Of Compressor and Low-Pressure Equipment

**(1)** **Cooling host:**

**(1)** **Quick freezing room** **+** **refrigeration room system:** **250kw**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Comp Model | Working conditions (Te/Tc) °C | Cooling capacity kw | Shaft power kw | Motor power kw | Number of units |
| MYCOM/SABROE/GRASSO or Equiavlent | -40℃/+35 | 142.43 | 119.65 | 132 | 2 |

**\* Note: Starting system of compressor shall frequency converter/soft starter to reduce starting torque to gen sets（Match)**

## (2) Low-Pressure Circulating Liquid Storage Tank and Ammonia Pump:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| name | Low-pressure circulation barrel | | Ammonia pump | | |
| Quantity × model | Single parameter | quantity | Single parameter | remark |
| Freezing room + refrigeration room | 1×MYCOM/SABROE/GRASSO | Volume 3m³ | 3 units | Flow rate 2.8m³/h, head 32m | Dual-use, one-piece |

**(3) End heat exchange equipment:**

The evaporator in the quick-freezing room and refrigeration room is made of suspended ceiling aluminum tube aluminum sheet air cooler, which adopts stainless steel shell.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Cold room name  call | space  number | Studio area  ㎡ | Evaporation temperature  Degree °C | Single room equipment load  kw | Fan model | The number of units × |
| Quick freezing room | 1 | 50 | -40 | 280 | MYCOM/SABROE/GRASSO/80 | 1×4（Q=70kw） |
| refrigerator | 1 | 218 | -40 | 31.6 | MYCOM/SABROE/GRASSO/80 | 1×2（Q=11kw） |

## Selection Of Other Auxiliary Equipment:

1. condenser:

The condensation temperature is +35°C, and the average outdoor temperature of 50 hours per year in summer is not guaranteed: +28.1°C, and the heat dissipated. on coefficient is 0.71. The freezer + cold storage refrigeration system selects 1 MYCOM/SABROE/GRASSO or evaporative condenser produced in-house, with a total heat discharge of 750KW. Meet system requirements.

Due to the high temperature in the Maldives all year round, it is recommended to enlarge 1.2 times the selection, MYCOM/SABROE/GRASSO or equivalent evaporative condenser, heat exchange 1200KW, which is characterized by a small footprint, compact structure, high heat exchange efficiency, low water consumption, small power consumption, corrosion resistance, long service life, which can greatly reduce the operation and management costs.

(3) 3. End heat exchange equipment:

Refrigerated air cooler in the Cold store., the evaporator shall be made of stainless-steel tubes, aluminum sheet air cooler, evaporation temperature -40 °C, the heat exchange of each fan is 70KW, the heat exchange area is 130 m2, air volume 22000m3/h, wind pressure 290pa, range 28m. There are 2 units in 1 library.

The whole freezer in the cold air, the evaporator is made of ceiling type stainless steel tube aluminum sheet air cooler, when the evaporation temperature is -40 °C, the heat exchange of each fan is 70KW, and the heat exchange area is 550m2, air volume 66000m3/h, wind pressure 290pa, range 28m. There are 4 units in 1 library.

(4) The oil cooler adopts a siphon:

or equivalent, the thermal siphon refrigeration cycle is most suitable for areas with poor water quality or systems with evaporative condensers. Its characteristics: the unit is small, the oil cooling is reliable, and the oil temperature after cooling is generally more than the condensation

The temperature is 10°C-20°C. Compared with the water-cooled type, there is no need for cooling water, and the waterway system is simplified

There is no problem of heat exchange tube fouling affecting the heat exchanger, which can improve the cooling efficiency.

There is also no effect on compressor exhaust and power consumption. At the same time, it also has the effect of assisting the reservoir.

### (5) Reservoir:

The system designed a horizontal reservoir to be used to store ammonia in the system.

### (6) Oil collector:

1 oil collector is to be selected to meet the requirements of use.

### (7) Automatic air separator:

1 air separator produced in-house is to be selected to meet the requirements of use.

### (8) Emergency ammonia leaker:

1 set of emergency ammonia dischargers is to be selected to meet the requirements of use.

1. Drainage bucket:

It is mainly used to discharge the ammonia in the cold room when the hot air is defrosted, and the maximum amount of ammonia stored in the cold room is stored in the drain bucket, and it does not exceed 70% of the drain bucket to select the type. If you do not use hot gas to melt, you can not use an exhaust bucket.

**10. System Description:**

1. All valves, instruments, and automatic control components of the ammonia refrigeration system are to be made of ammonia-specific products.
2. Safety valves are to be provided on the reservoir, evaporative condenser, oil collector and screw compressor unit oil separator. The liquid reservoir and oil collector are set up to display the level gauge on-site.
3. The ammonia system pipes are all to be made of 20# seamless steel pipes for transporting fluids (GB/T8163-2008), and the pipe diameter steel pipes not larger than φ20 are all made of 304 stainless steel seamless pipes. φ38 and above system pipes are based on argon arc welding and arc welding cover. (all diameters are estimations)
4. The ammonia system low-temperature equipment and tube bundle insulation adopt polyurethane on-site foam insulation, and single tube insulation adopts rigid polyurethane thermal insulation pipe tiles. The external protective layer of the insulation of the machine room equipment is to be selected from a 0.6mm thick aluminum plate, and the outer protective layer of pipeline insulation is selected from a 0.8mm thick aluminum plate.
5. The ammonia system pipe to adopt the suspended ceiling pipe frame structure. From the roof of the machine, the house reserved a lifting point downwards to lead out the pipe boom, cross-bearing. Between the low-temperature insulation pipe and the support and hanger, between the low-temperature container and the foundation, a mat to be soaked in asphalt is added to prevent the formation of a cold bridge. The evaporative condenser is located on the roof of the chiller house.
6. Refrigeration system pipes and equipment are coated with anti-rust primers and topcoats. Insulation pipes and equipment are to be adjected on the outer protective layer

Goal awareness. The color mark of the paint is in accordance with the provisions of the Cold Storage Design Code.

**11. System security:**

1. Device security

The compressor unit must have perfect protection alarm measures such as oil pump motor overload, main motor overload, exhaust pressure ultra-high, low oil pressure, large suction pressure difference, ultra-high oil temperature, and unmoved spool valve the liquid pump must have protection such as small pressure difference, ultra-high filter resistance, motor overload, and automatic bypass of overpressure.

1. NH3 Leak Detection Alarm Exhaust System ≦

The upper part of the refrigeration room is to be provided with an ammonia leakage alarm device, which has the function of alarming the concentration is too high. The explosion-proof accident exhaust fan in the machine room is to be linked with the working medium leakage alarm to open the ventilation when the working fluid leaks.

1. NH3 venting

The owner needs to set up an emergency ammonia discharge tank near the machine room for the discharge of all the ammonia in the machine room in an emergency.

12. Other matters

1. During civil construction, the craftsman should pay close attention to the location of the pipeline through the wall, the hole through the floor slab and the position of the buried hanging point or the embedded bolt for the cemented pipeline, etc., and if it is found that there is a discrepancy, it should be corrected in time. In order to better strengthen the pipeline, if there is an inappropriate place found in the construction, the reinforcement point can be added or changed as appropriate, and the anchor bolt position of the machine and equipment foundation must be checked with the actual object before it can be buried.

1. In the construction and installation process of the refrigeration system, the industry standard "Ammonia Refrigeration System Installation Engineering Construction and Acceptance Specification" should be strictly observed
2. Other outstanding matters shall comply with the current normative requirements of the country.

Appendix (1): Refrigeration pipe insulation layer thickness table

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ℃  Pipe diameter | D273 | D219 | D159 | D133 | D108 | D89 | D76 | D57 | D45 | D38 | D32 | ≦D25 |
| -28 | 110 | 100 | 90 | 90 | 90 | 80 | 80 | 70 | 70 | 70 | 60 | 60 |
| -8 | 90 | 90 | 80 | 80 | 80 | 80 | 70 | 70 | 70 | 60 | 60 | 50 |

Appendix II: Refrigeration equipment insulation layer thickness table

|  |  |  |  |
| --- | --- | --- | --- |
| serial number | name | Model | Insulation thickness |
| 1 | The horizontal barrel pump unit |  | 160MM |
| 2 | Drain bucket |  | 100MM |

Schedule III: List of major refrigeration equipment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| serial number | Device name | Specifications and models | unit | quantity | remark |
| 1 | Screw compressors | Cooling capacity: 142.43KW Motor power: 132KW | platform | 2 | The compressor should be well-known brands such as MYCOM/SABROE/GRASSO. Preference is MYCOM/SABROE  Starting system of compressor shall frequency converter/soft starter to reduce starting torque to gen sets |
| 2 | Horizontal barrel pump unit | Flow rate: 2.8m3/h, one for one use | platform | 1 |  |
| 3 | Evaporative condenser | Heat exchange: 1200kw, motor power 15KW | platform | 1 |  |
| 4 | Siphon |  | platform | 1 |  |
| 5 | High pressure reservoir |  | platform | 1 |  |
| 6 | Stainless steel tube aluminum sheet air cooler | Cooling capacity: 15KW heat transfer area: 130m2, cold storage | platform | 1 |  |
| 7 | Stainless steel tube aluminum sheet air cooler | Cooling capacity: 15KW heat transfer area: 130m2, cold storage | platform | 1 |  |
| 8 | Stainless steel tube aluminum sheet air cooler | Cooling capacity: 70KW heat transfer area: 550m2 | platform | 1 | Cold store must be able to bring down,20 tons of Tuna from -15oto -22 oC within 12 hours and maintain 200 tons of frozen Tuna within --22oC-24oC. |
| 9 | Stainless steel tube aluminum sheet air cooler | Cooling capacity: 70KW heat transfer area: 550m2 | platform | 1 |  |
| 10 | Stainless steel tube aluminum sheet air cooler | Cooling capacity: 70KW heat transfer area: 550m2 | platform | 1 |  |
| 11 | Stainless steel tube aluminum sheet air cooler | Cooling capacity: 70KW heat transfer area: 550m2 | platform | 1 |  |
| 12 | Oil concentrator |  | platform | 1 |  |
| 13 | Emergency ammonia drain |  | platform | 1 |  |
| 14 | Air separator |  | platform | 1 |  |

**\* 20 tons of Tuna from -15oto -22 oC withing 12 hours and maintain 200 tons of frozen Tuna withing -22oC-24oC.**

**Installation instructions for ammonia systems**

First, the installation of machinery and equipment

This description is one of the design documents, is the technical requirements of the refrigeration process design for the installation project, the engineering installation should be built according to the construction drawings, this description has the same effect.

1. The installation requirements of ammonia compressors and units (including commissioning and acceptance requirements) shall comply with the relevant provisions and requirements in the "Specifications for the Construction and Acceptance of Installation Projects of Refrigeration Equipment and Air Separation Equipment" (GB50274-2010).
2. (2) After the installation of the unit, the empty car should be operated for 6H, the empty car should be operated for 24H after the load operation is qualified, and the lubricating oil and cleaning piston should be replaced after the load operation.
3. System piping installation
4. The pipe is made of steel pipe (seamless steel pipe), the quality of the pipe must be checked one by one before installation, impurities and oxide scale must be removed, and the inside of the pipe must be very clean. Clean pipes must be plugged with corks at both ends and must not be stored in the open. The inner wall of the seamless steel pipe should not be galvanized.
5. The seamless steel pipes are welded by argon arc welding primer and electric welding cover.
6. The ammonia system pipeline should have a slope, the exhaust pipe should have a 1 to 2% aspect oil separator, and the suction pipe should be sloped from the evaporator to the compressor, and there should be a slope of not less than 2%
7. For the finished stamping elbow with a curvature radius R=3.5D for seamless steel pipes, the on-site pipe bending production and its quality requirements should comply with the relevant provisions of the current national standard "Industrial Metal Pipeline Engineering Construction and Acceptance Specifications" GB50235.
8. valve
9. Ammonia system with a variety of valves (such as shut-off valves, throttle valves, solenoid valves, etc.), must use ammonia special products, all valves should be clear flow direction installation.

(2) The solenoid valve should be energized before installation to verify whether it is sensitive and reliable, and the power supply voltage should be consistent with the nameplate.

(3) Globe valves, check valves, solenoid valves and other valves should check whether the valve mouth sealing line is damaged, and the valve door with packing must check whether the packing can be sealed well, and if necessary, it must be replaced. The valve is used after descaling and anti-rust treatment.

(4) Before the installation of the safety valve, the lead seal and the factory certificate should be checked, and if the specified pressure does not match the design, the valve should be unsealed and adjusted according to the regulations.

(5) After the valve is cleaned, the valve should be opened and closed 4 to 5 times, and then the valve should be closed and the leak test should be tested with nitrogen (or injected with kerosene, and it will not leak for two hours to be qualified);

(6) In the process of transportation, storage and placement, the valve should be blocked at both ends (except for the takeover end), should be placed in a ventilated and dry place, not allowed to be stored in the open air, and not allowed dirt, water, etc. to enter the valve, causing the valve to scale and rust again.

(7) The valve must be installed straight.

Fourth, the system discharge, pressure test, leak detection

(1) System sewage: After the system is installed, 600KPa (gauge pressure) nitrogen is used for segmented sewage blowing, and then the whole system is blown, and the sewage discharge shall not be less than 3 times. And use white paper to test at the sewage outlet until the gas is discharged without water vapor, oil pollution, rust, and other debris.

(2) After the system is discharged, the air tightness and air pressure test should be carried out, and the test pressure should be shown in the pressure characteristic table. Bottled high-pressure nitrogen must be perfused with a decompression table.

(3) When testing pressure, in addition to the suction and exhaust valves of the compressor, the globe valve in front of the safety valve and the valve that connects the atmosphere, all the valves on the pipeline are opened, and the refrigeration installation of the whole system is completed through the fluorine valve, and after the load trial operation is qualified, it is inspected according to the relevant regulations and formal acceptance procedures are handled. Unified inflation. When the system reaches the specified pressure, check each weld, flange, and valve with soap liquid and carefully observe whether there is leakage. Where the leakage is large, there is a small sound, and a large foam appears, and where the leakage is small, there is a small foam intermittently, so the leak detection must be careful and repeatedly checked 3 to 5 times. The leak should be marked, repaired after the pressure is removed, and then tested until the leak is completely eliminated. Then the system is maintained for 24 ~ 48h, if the pressure is not reduced, the test pressure is qualified.

(4) After the system discharge and pressure test are completed, all valve spools should be cleaned.

Fifth, the vacuum test

(1) After passing the air tightness test, the vacuum test is carried out, the purpose of the vacuum test is to further check the air tightness of the system and eliminate air and other non-condensable gases, and to evaporate the water in the system.

(2) The vacuum test uses a vacuum pump system to evacuate.

(3) The system is pumped with a vacuum pump to a residual pressure of less than 5.333KPa (40mmHg) and runs continuously for 10 to 24h in order to evaporate the water of the system. And keep the remaining pressure in the system 5.333KPa placed for 24h, the system boost should not exceed 0.667KPa (5mmHg), such as the reason for the recovery, is the system not strict, or due to the evaporation of water in the system, the water vapor sub-pressure rises caused, If the system is not strict, the air tightness test should be redone.

Sixth, the insulation of equipment and pipelines

(1) After the above pressure test and vacuum test are qualified, before perfusion of Freon, the equipment and pipelines working under evaporation pressure should be covered with an insulation layer located in a room at room temperature.

(2) The construction of the insulation layer should be strictly in accordance with the requirements, and the insulation layer must be dense and firm with the equipment and pipelines, and there must be no gaps.

(3) Equipment and pipes working under condensation pressure are not insulated.

(4) The pipe insulation layer is made of polyurethane insulation.

Seven, filled with ammonia refrigerant

(1) Before the ammonia system is filled with ammonia, it is necessary to repeatedly check the safety of the equipment, the opening of the valve, and it is best to have the safety department personnel confirm the safety of the situation on the spot to carry out ammonia filling.

(2) Ammonia filling requires 2-3 professional production personnel to cooperate with each other, familiar with the knowledge of ammonia, know the tight handling method of ammonia, and wear safety clothing for ammonia filling.

(3) The amount of ammonia filled should be in accordance with the design requirements and should not exceed 70% of the reservoir.

8. Trial operation

After the system is filled with ammonia, it can be transferred to trial operation, and the purpose of the trial operation is to check whether the system is normal and whether the amount of ammonia charged is appropriate. If the ammonia is charged too much, it will make the suction, exhaust (7) valve must be installed straight. The pressure is too high, the machine is easy to punch the cylinder, then the excess ammonia should be extracted, such as insufficient ammonia filling, will produce suction, the exhaust pressure is low, the return air is overheated, the library temperature cannot be reduced and other phenomena, then should be supplemented with ammonia, until the operation is normal.